WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1) or any other requirements, or both, which may be applicable to the user.

Installation, operation, and maintenance should only be performed by qualified personnel.

TM-111960-G2-1

VOLUME 1 -- OPERATOR'S MANUAL

626-PA-6024B

THREE-PHASE AC CURRENT HARMONIC ANALYZER

15 June 1986

(Rev. 10/1/86)
(Rev. 4/15/88)
(Rev. 9/1/89)
(Rev. B)

See opposite side relative to proprietary rights.

Note: Refer to Volume 2 (Service Manual) of TM-111960-G2 for maintenance information.

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HAWKER SIDDELEY DRANETZ

DRANETZ TECHNOLOGIES, INC.
1000 New Durham Rd.
Edison, New Jersey 08818

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IMPORTANT! CALIBRATION INTERVAL

The recommended calibration interval for this unit is once every 12 MONTHS.

We recommend that you return the unit to the factory for calibration. If you decide to do so, first contact the Dranetz Customer Service Department to obtain an authorization number.

Telephone Number:	(201) 287-3680
Telex Number:	499-7808
TWX Number:	(710) 997-9553
FAX Number:	(201) 248-9240
Cable:	DRANETZ

Then fill out the Repair/Service Order form enclosed in this manual and ship it along with the unit to the Dranetz Customer Service Department. (If this form is missing, ask the Dranetz Customer Service Department for a replacement.)

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The information in this manual has been reviewed and is believed to be entirely reliable. No responsibility, however, is assumed for any inaccuracies. The material in this manual is for information purposes only, and is subject to change without notice.

IMPORTANT

All 6024B plug-ins beyond Serial Number 690116XXX, Lot #4690-1 can be used with the TR-2019A current probe supplied with the plug-in, or with any of the following probes:

- TR-2021 probe (P/N 114700-G1)
- CT Termination Box (P/N 110635-G2)
- CT Termination Box (P/N 110635-G2) in conjunction with the TR-2015A probe (P/N 114390). The Termination Box and probe are packaged together as P/N 110639-G1.
- CT Termination Box (P/N 110635-G2) in conjunction with a probe with a 5A rms full scale secondary.

When using probes other than the TR-2019A, the plug-in's readings must be adjusted by the user to compensate for the difference in amperage supplied to the 6024B by the other probes. Refer to Appendix A for more information and a table of required adjustments.

If the TR-2019A probe is used, no adjustments need to be made.

VOLUME 1
OPERATOR'S MANUAL

626-PA-6024B THREE-PHASE AC CURRENT HARMONIC ANALYZER

SECTION I
GENERAL INFORMATION

1.1 SCOPE

The manual for this product consists of two volumes. Volume 1, the Operator's manual, is divided into three sections: (I) GENERAL INFORMATION, (II) INSTALLATION AND OPERATION, and (III) OPERATIONAL TEST. Volume 2, the Service manual, contains the maintenance instructions and consists of four sections, IV through VII. (See Volume 2 for a description of these sections.)

1.2 INTRODUCTION

Volume 1 of this manual provides Operator's instructions for the 626-PA-6024B Three-Phase AC Current Harmonic Analyzer plug-in module, also referred to as the 6024B plug-in. The 6024B plug-in is intended for use in a Series 626 Mainframe. Before reading these instructions further, you should be familiar with the information described in the Mainframe manual.

1.3 PURPOSE

The 6024B monitors harmonic distortion of current waveforms on three-phase ac power lines. Clamp-on current probes are used for each of three channels to measure current up to 300 A rms, with a maximum crest factor of 5, over a frequency range of 47 to 63 Hz. The plug-in reports disturbances when the total harmonic distortion (THD) of any channel exceeds a programmable threshold. It also reports a disturbance when the THD changes as much as the programmed sensitivity.

Disturbance printouts include the percentage of THD, root-mean-square (rms) current at the fundamental frequency, and values for each harmonic up to and including the seventh expressed as a percentage of the fundamental. A separate voltage input is provided for use as a frequency reference. THD thresholds and sensitivities are separately programmable for each channel.

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1.4 APPLICATIONS

When installed in the Mainframe, the 6024B plug-in monitors changes in the total harmonic distortion present in the current waveform on ac power lines. Among the typical applications are:

-- Verifying that the harmonic content in the ac power supplied to sensitive equipment (such as computers) is within manufacturer's specifications.

-- Determining if electrical components (such as transformers and inductors) are being stressed due to power dissipation at harmonic frequencies.

-- Identifying excessive harmonic currents caused by nonlinear loads (such as switching power supplies).

1.5 EQUIPMENT CHARACTERISTICS

The 6024B is configured as a plug-in module 6.5" high by 1.25" wide by 10.25" deep. It may be installed in any one of five slots of the Series 626 Mainframe. Technical specifications of the 6024B are presented in Table 1-1.

1.5.1 Absolute Maximum Ratings: Cautions

Be aware of the following cautions when applying input voltage and installing TR-2019 current probes.

CAUTIONS

DO NOT exceed ac voltage of 600 V rms, referenced to safety ground, to input terminals marked "+" or "-" on the SYNC VOLTAGE connector.

DO NOT install TR-2019 current probes on conductors carrying more than 300 A rms.

DO NOT install TR-2019 current probes on conductors to which more than 600 V rms, referenced to safety ground, is applied.

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Table 1-1. 6024B Plug-in Technical Specifications

Current Measurement Inputs:	(3) TR-2019 current probe connectors are included (P/N 111666)
Sync Voltage Input:	3-position pin and socket connector with (2) high-impedance inputs plus safety ground. Impedance is 40 Megohms, each side to ground. A cable assembly is included (P/N 110597)
Sync Voltage Input Range:	50 to 600 V rms
Current Measurement Range:	3 to 300 A rms
Maximum Crest Factor:	5
Input Frequency Range:	47 to 63 Hz fundamental
THD High Limit: (user-progammable)	1% to 255% THD
THD Sensitivity: (user-programmable)	1% to 255% THD
THD Measurement Resolution:	0.1% THD
THD Measurement Accuracy:	±5% of reading, ±1% (See Note)
Fundamental Measurement Resolution:	0.1A rms
Fundamental Measurement Accuracy:	±1% of reading, ±0.2% F.S.
Harmonic Measurement Resolution:	0.1% of fundamental voltage
Harmonic Measurement Accuracy:	±5% of reading, ± 1% (See Note)
Current Probe Calibration Accuracy:	±1% (See Note)

NOTE

Measurement accuracy specifications do not include the accuracy of the current probes. The total error for a particular measurement is the sum of the specified measurement accuracy and the current probe calibration accuracy. Contact Dranetz Technologies, Inc., Sales Dept. (201-287-3680) if higher accuracy is required.

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1.6 MEASUREMENT CAPABILITIES

1.6.1 General

The 6024B plug-in operates by measuring the total harmonic distortion (THD) of the signals applied to its inputs, and generating printouts based on changes in the measured THD. Along with THD values, the plug-in also provides values for the amplitude of the fundamental plus the relative levels of the second through the seventh harmonics. The amplitude of the fundamental is expressed as root-mean-square (rms) current. The relative levels of the second through seventh harmonics are expressed as percentages of the fundamental.

1.6.2 Definition of Total Harmonic Distortion

Values for THD are calculated according to the following definition:

$$THD = 100 * \left(\frac{[\text{sum of squares of rms amplitudes of 2nd through 7th harmonics}]^{\frac{1}{2}}}{[\text{rms amplitude of the fundamental}]} \right)$$

In words, the total harmonic distortion as measured by the 6024B plug-in is defined as the value equal to 100 times the ratio of the square root of the sum of the squares of the root-mean-square amplitudes of the individual harmonics up to and including the seventh, to the root-mean-square amplitude of the fundamental. This is NOT the same as the sum of the relative levels of the harmonics.

1.6.3 General Operational Description

While in the Operate Mode, the 6024B plug-in performs approximately seven measurements per second. Each measurement consists of three parts: sampling, computation, and analysis. At the end of each measurement, any disturbances detected will be processed for printing, summary information will be updated, and new present values will be made available.

1.6.3.1 Sampling

The currents applied to the module's inputs are sampled 32 times per ac cycle over four consecutive ac cycles. The samples for all four ac cycles are then averaged, resulting in 32 samples per channel upon which all calculations are based. The sampling period is synchronized to the SYNC VOLTAGE input.

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1.6.3.2 Computation

The rms amplitudes for all frequency components from the fundamental to the seventh harmonic are calculated using a discrete fourier transform (DFT). These rms values are then used to calculate the THD and the levels of the individual harmonics relative to the fundamental.

1.6.3.3 Analysis

The new THD value is compared with the THD from the previous measurement to determine the amount of change. If the change was equal to or greater than the programmed THD sensitivity, an INCrease or DECrease is reported. The THD value is also compared with the programmed THD high limit to determine if an out-of-limits condition exists. If the new THD value is higher than the THD high limit, and the THD from the previous measurement cycle was not, a "high" disturbance is reported. In subsequent measurements, as long as the THD remains above the THD high limit, the plug-in will keep track of the highest THD value achieved and the duration of the out-of-limits condition (up to 652.8 seconds).

When the THD returns to a level within limits, the plug-in will report that the distortion has returned to normal, the highest THD value achieved while out-of-limits, and the duration of the out-of-limits condition (within 0.1 seconds).

1.6.3.4 Sync Lost Condition

The plug-in can detect changes in the fundamental frequency of the signal used for synchronization. If frequency changes are detected during sampling, the plug-in will report a "SYNC LOST" condition, and no further measurements will be taken until four consecutive cycles occur with no change in frequency. When a steady-state condition is established, the plug-in will report "SYNC RESTORED" and continue its normal monitoring operation.

1.7 STANDARD ACCESSORIES

Part #	Quantity	Description
TM-111960-G2 Vol. 1	1	Operator's Manual
111666	3	TR-2019 Current Probes
110597	1	AC Cable Assembly w/Plug

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1.8 OPTIONAL ACCESSORIES

Part #	Quantity	Description
TM-111960-G2 Vol. 2	1	Service (Maintenance) Manual

1.9 FACTORY REPAIR

When factory repair is required, proceed as follows:

1. Contact Dranetz Customer Service Department to obtain an authorization number for factory repair:

   Telephone No: (201) 287-3680

   TWX: (710) 997-9553

   FAX: (201) 248-9240

   Telex: 499-7808

   Cable: DRANETZ

2. Fill out the REPAIR/SERVICE ORDER form enclosed in the Series 626 Operating manual. Ship it along with the malfunctioning equipment to the Dranetz Customer Service Department.

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SECTION II
INSTALLATION AND OPERATION

2.1 GENERAL

This section contains the installation, programming, and operating instructions for the 6024B plug-in.

2.2 LOAD RATINGS

The Series 626 standard Mainframe has an upper limit of the combined total rating of its installed modules. The overall Mainframe capacity is set at 20 units. The individual modules (existing as of this printing) have the following load ratings:

Table 2-1. Load Ratings

Plug-in	Load Rating	Plug-in	Load Rating
626-PA-6001	2 Units	626-PA-60012A	3 Units
626-PA-6001 with Extra Option Board	3 Units	626-PA-6013	2 Units
626-PA-6002	2 Units	626-PA-6014	1 Unit
626-PA-6003	4 Units	626-PA-6015	4 Units
626-PA-6005	2 Units	626-PA-6018	4 Units
626-PA-6006	2 Units	626-PA-6020	4 Units
626-PA-6007	1 Unit	626-PA-6024A	4 Units
626-PA-6008	2 Units	626-PA-6024B	4 Units
626-PA-6009	4 Units	626-PA-6025	4 Units
626-PA-6011	1 Unit	626-PA-6030	6 Units
626-PA-6012	2 Units	626-PA-6037	1 Unit
		626-PA-6038	1 Unit
		626-PA-6040	6 Units

NOTE

When selecting modules for installation into any Series 626 Mainframe, verify that the sum of the load ratings of the installed modules DOES NOT exceed 20 units.

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2.3 INSTALLING THE PLUG-IN MODULE INTO THE MAINFRAME

To install the 6024B plug-in into the Mainframe:

WARNING

Be sure that the Series 626 Mainframe and all of the power connected to its plug-in modules are first turned OFF before proceeding with any installation.

(1) Remove the 6024B plug-in from its packaging.

(2) With the rear panel markings of the module reading correctly, carefully slide the module into the upper and lower card-guide tracks of the desired slot until it is firmly seated.

(3) Tighten the top and bottom captive screws to secure the module into the Mainframe.

2.4 CONNECTING POWER SOURCE TO THE MODULE

CAUTION

To avoid damaging the equipment, DO NOT exceed the absolute maximum ratings given in the CAUTIONS of Subsection 1.5.1.

WARNING

Because of possible shock or fire hazards, connection of this instrument should be performed in compliance with the National Electric Code (ANSI C1), or any other requirements, or both, which may be applicable to the user.

Installation, operation, and maintenance should only be performed by qualified personnel. Your qualifications for doing so should be self-determined.

2.4.1 Input Connection Instructions

The 6024B plug-in is equipped with three connectors labeled "PHASE A," "PHASE B," and "PHASE C." The connectors accept three TR-2019 current probes (P/N 111666), plus a separate 3-position pin and socket connector (labeled "SYNC VOLTAGE") for ac voltage.

All measurements are synchronized to the voltage applied to the SYNC VOLTAGE connector. This voltage must therefore be derived from the ac source providing current to the monitored conductors.

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The three positions of the SYNC VOLTAGE connector are labeled "+," "-," and "⏚." The "+" and "-" positions are high impedance voltage inputs; the "⏚" position is internally connected to safety ground. The proper connection procedure follows.

(1) Turn the Mainframe off by inserting the key into the FUNCTION key switch on the front panel and setting the switch to "OFF." Unplug the Mainframe from the power source.

(2) Turn off the power source(s) to be monitored by the module.

(3) Turn off the source providing the synchronization voltage.

(4) Connect the cable assembly (P/N 110597) to the SYNC VOLTAGE connector; connect the plug on the end of the cable assembly to the source providing the synchronization voltage.

(5) Attach the current probe connectors to the mating connectors on the rear panel; install the current probes on the desired lines.

(6) Plug the Mainframe back into the power source. Turn on the Mainframe by turning the FUNCTION key switch to "OPERATE."

(7) Turn on the source providing the synchronization voltage.

(8) Turn on the power source(s) to be monitored.

2.4.2 Circuit Applications

WARNING

Conductors connecting to measurement points should be approved for the specific use. When connected to branch circuits of 20 amperes or less, the minimum flexible cord size is No. 18 AWG (1 mm square). For branch circuits with higher ampacity, refer to National Electric Code (ANSI C1-1975), paragraphs 240-4 and 250-95. Special consideration of ground may be required. (Refer to Article 250 of above reference if in doubt.) Outside of the United States, consult the applicable safety standards.

The 6024B may be used to monitor harmonic distortion on three-phase four-wire (Wye), three-phase three-wire (Delta), or three separate power lines. Figures 2-1, 2-2, and 2-3 illustrate proper connections for all recommended applications.

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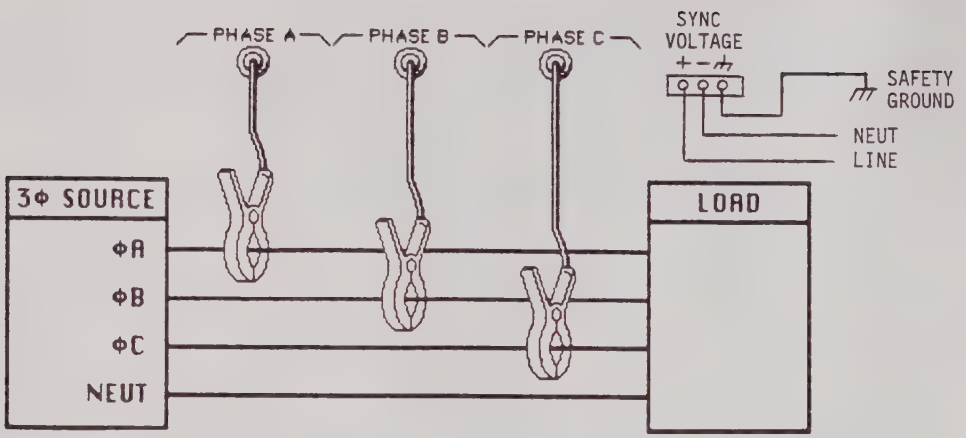

Figure 2-1. Line-to-Neutral (Four-Wire) Input Connections

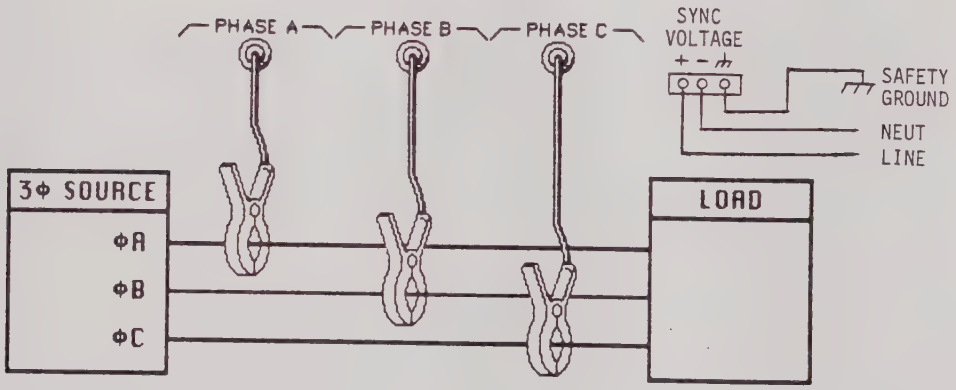

Figure 2-2. Line-to-Line (Three-Wire) Input Connections

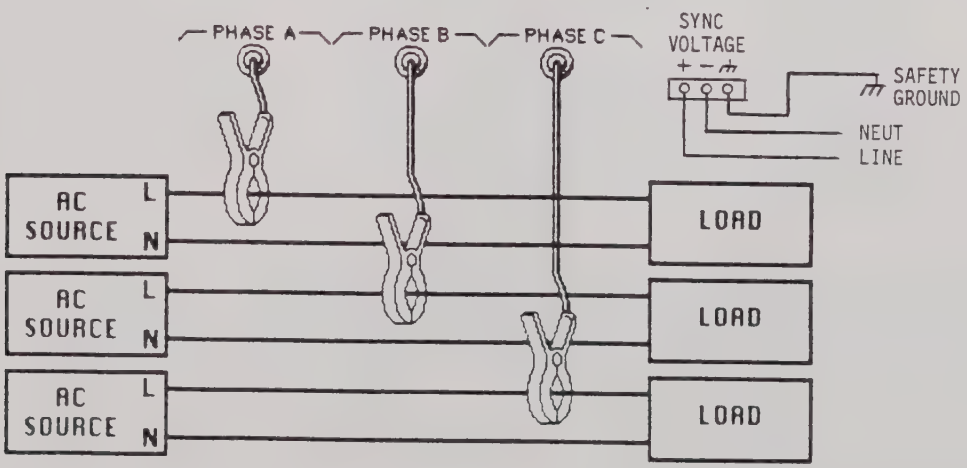

Figure 2-3. Separate Sources Input Connections

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2.5 OPERATING THE 6024B PLUG-IN

2.5.1 Operating Controls and Indicators

The functions of the Mainframe operating controls and indicators associated with the 6024B plug-in are described in Table 2-2. Figure 2-4 shows a typical front panel of a Mainframe and its controls associated with the 6024B plug-in. For a description of controls common to overall Series 626 operation, refer to Volume 1 of your Mainframe manual.

Table 2-2. 6024B Plug-in Operating Controls

ITEM	FUNCTION
Numerical Keys*	Used to enter numerical values for the various functions.
[HI LIMIT] Key	When pressed in Program Mode while the red LED above the red keys is lit, this key enables the unit to accept a new value for the THD high limit.
[SENS] Key	When pressed in the Program Mode while the red LED above the red keys is lit, this key enables the unit to accept a new value for THD high limit.
[INPUT] Key	When pressed in Program Mode, this key initiates the programming for a single channel.
[ENTER] Key	When pressed, transfers the entered numerical value into the plug-in's non-volatile memory and checks for errors.
[CLEAR ENTRY] Key	When pressed in the Program Mode while entering a new value, cancels the current entry.
[PROG] Button*	When pressed in the Operate Mode, produces a Program Summary printout. Also active in the Program Mode while the INPUT LED is lit.
[DATA] Button	When pressed in the Operate Mode, produces a Data Summary printout along with the present values measured from the inputs.
[PRESET] Button	When pressed in the Program Mode, programs all three channels with their factory preset values.
* -"Key" and "Keyboard" represent the red, green, and yellow keys; "Button" represents the black selector buttons.	

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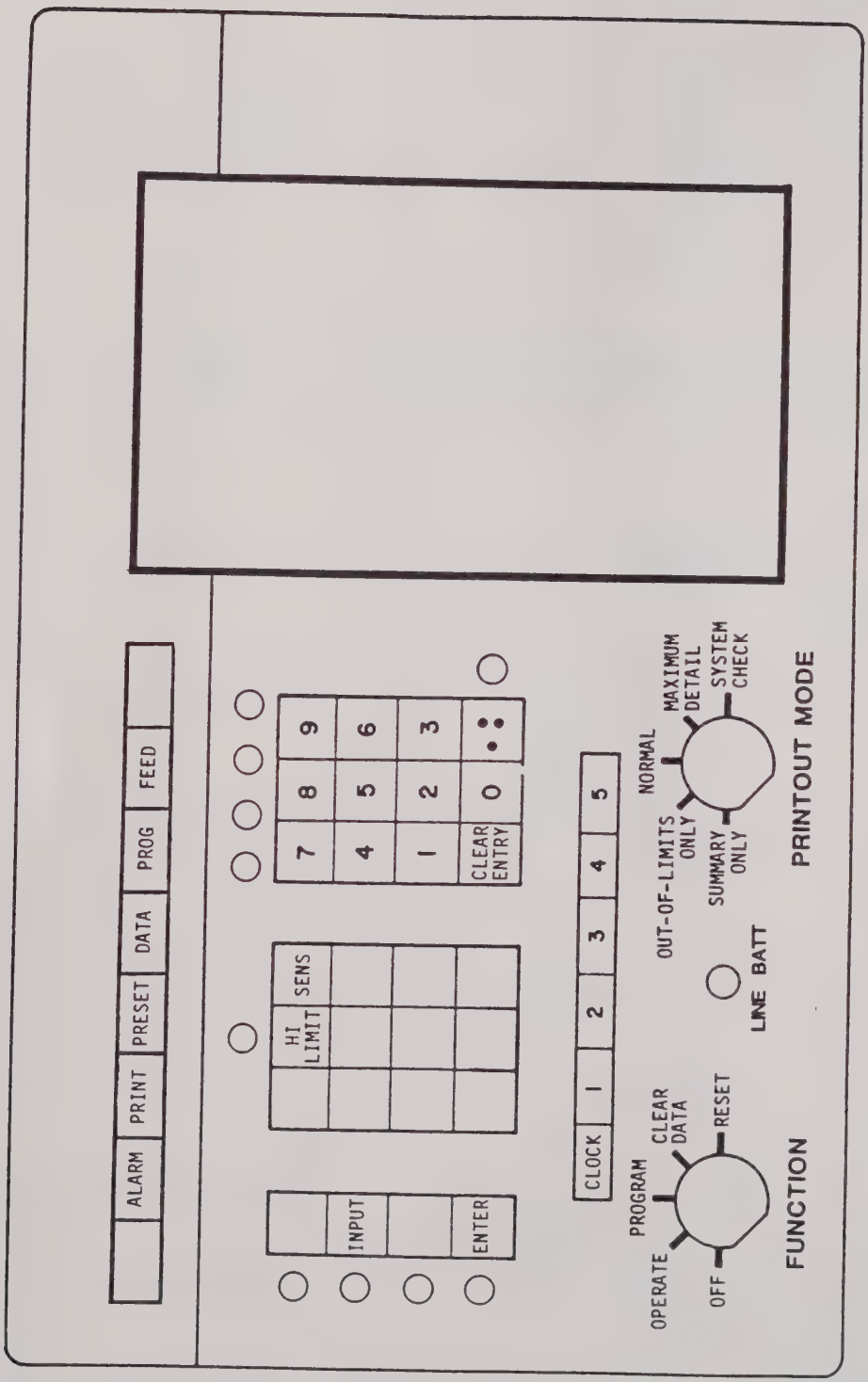

Figure 2-4. Series 626 Controls used by the 6024B Plug-in

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2.5.2 Programmable Limits and Thresholds

The 6024B plug-in generates disturbance printouts based on comparison of the measured THD with two user-programmable parameters: THD high limit and THD sensitivity. The module will report an out-of-limits condition when the measured THD exceeds the programmed THD high limit; it will report an INCrease or DECrease when the THD changes as much as or more than the THD sensitivity.

The THD high limit should be set to the maximum percentage value of the total harmonic distortion considered acceptable for the power line being monitored. The THD sensitivity should be set so that the module will report significant changes in THD without generating extraneous data.

2.5.3 Programming Procedure

Typically, new values for THD high limit and sensitivity are set for all three channels at once; however, individual channels may also be programmed separately.

2.5.3.1 Programming all Channels Simultaneously

The clearest way of explaining the simultaneous programming is through an example. Assume that for all three channels:

a. THD greater than 5% is out-of-limits,

b. Changes in THD of 2% or more should be recognized.

To program the 6024B plug-in with these values:

(1) Set the FUNCTION key switch to "PROGRAM."

(2) Press the channel button (1-5) corresponding to the slot position of the 6024B plug-in. Note that a Program Summary for that channel is immediately printed.

(3) The red LED above the red key group lights, indicating that one of the parameters from this group may be selected. For the 6024B plug-in, only the [HI LIMIT] and [SENS] keys are active. For the purposes of this example, set the high limit first by pressing [HI LIMIT].

(4) Three yellow LEDs above the yellow key group light, indicating that a 3-digit value is expected, representing the THD high limit percentage. For this example (5%), press [0], [0], [5].*

(5) The green LED next to the [ENTER] key will light. Press [ENTER]. The message "THD HILIM 005%" will be printed to confirm the newly programmed value.

---

* If an incorrect entry is made, press [CLEAR ENTRY] and begin over.

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(6) The red LED above the red key group lights, indicating that another parameter may now be selected. Press [SENS].

(7) Three yellow LEDs above the yellow key group light, indicating that a 3-digit value is expected, representing the THD sensitivity percentage. For this example (2%), press [0], [0], [2].

(8) The green LED next to the [ENTER] key will light. Press [ENTER]. The message "THD SENS 002%" will be printed to confirm the newly programmed value.

2.5.3.2 Programming a Single Channel

As with the previous subsection, the clearest way of explaining single channel programming is through an example. Assume that for Phase C only the following is desired:

a. THD greater than 7% is out-of-limits,

b. Changes in THD of 3% or more should be recognized.

To program the 6024B plug-in with these values for Phase C:

(1) Set the FUNCTION key switch to "PROGRAM."

(2) Press the channel button (1-5) corresponding to the slot position of the 6024B plug-in. Note that a Program Summary for that channel is immediately printed.

(3) The red LED above the red key group lights, indicating that one of the parameters from this group may be selected. DO NOT press one of the indicated keys (keys with lit LEDs next to them); instead, press [INPUT].

(4) One yellow LED above the yellow key group lights, indicating that a 1-digit choice is expected. Pressing [1], [2], or [3] will select Phase A, Phase B, or Phase C, respectively. For this example (Phase C), press [3].

(5) The red LED above the red key group lights, indicating that one of the parameters from this group may be selected. Press [HI LIMIT].

(6) Three yellow LEDs above the yellow key group light, indicating that a 3-digit value is expected, representing the THD high limit percentage. For this example, press [0], [0], [7].

(7) The green LED next to the [ENTER] key will light. Press [ENTER]. The message "PHC THD HILIM 007%" will be printed to confirm the newly programmed value.

(8) The red LED above the red key group should be lit. To program the THD sensitivity, first press [INPUT].

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(9) Press [3] to select Phase C.

(10) Press [SENS].

(11) Press [0], [0], [3].

(12) Press [ENTER]. The message "PHC THD SENS 003%" will be printed to confirm the newly programmed value.

If an attempt is made to enter values outside the allowable ranges specified in Table 1-1, the message "ENTRY TOO HIGH" or "ENTRY TOO LOW" will be printed and new values must be entered.

When the plug-in's programming is completed, another plug-in may be selected for programming by pressing the appropriate channel. When all plug-ins in the unit have been programmed as desired, the Operate Mode may be selected by turning the FUNCTION key switch to "OPERATE.".

2.5.4 Selecting Factory Preset Values for the Plug-in

When the LED above the red key group is lit, the [PRESET] button may be pressed to cause all three channels to be programmed with factory preset values. A Program Summary, indicating the preset values, will then be printed. An example of such a printout follows:

626

```
THD SENS      005 %
THD HI LIMIT  005 %

      PHASE C

THD SENS      005 %
THD HI LIMIT  005 %

      PHASE B

THD SENS      005 %
THD HI LIMIT  005 %

      PHASE A

   626-PA-6024B
```

626A,G,R,ARA

```
   626-PA-6024B

      PHASE A

THD HI LIMIT  005 %
THD SENS      005 %

      PHASE B

THD HI LIMIT  005 %
THD SENS      005 %

      PHASE C

THD HI LIMIT  005 %
THD SENS      005 %
```

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2.6 DESCRIPTION OF DATA PRINTOUTS

While in the "Operate" Mode, the 6024B plug-in may produce four types of disturbance related printouts:

-- INCreases,
-- DECreases,
-- High distortion, and
-- Normal distortion.

2.6.1 INCrease Printouts

An INCrease printout indicates that the THD has increased by an amount equal to or greater than the programmed THD sensitivity. The printout includes the Mainframe's slot number (1-5), the channel phase letter (A, B, or C), the message "INC," the time of the occurrence (within 0.01 seconds), the new THD value, the fundamental amplitude in amperes rms, and the relative levels of the second through seventh harmonics. An example of an INCrease printout appears below.

626

```
3A INC 09:08:27.04
   THD      001.4 %
   HARM 7   000.3 %
   HARM 6   000.1 %
   HARM 5   000.8 %
   HARM 4   000.2 %
   HARM 3   001.2 %
   HARM 2   000.2 %
   FUND     115.3 A
```

626A,G,R,ARA

```
   FUND     115.3 A
   HARM 2   000.2 %
   HARM 3   001.2 %
   HARM 4   000.2 %
   HARM 5   000.8 %
   HARM 6   000.1 %
   HARM 7   000.3 %
   THD      001.4 %
3A INC 09:08:27.04
```

2.6.2 DECrease Printouts

A DECrease printout indicates that the THD has decreased by an amount equal to or greater than the programmed THD sensitivity. The printout includes the Mainframe slot number (1-5), the channel phase letter (A, B, or C), the message "DEC," the time of occurrence (within 0.1 seconds), the new THD value, the fundamental amplitude in amperes rms, and the relative levels of the second through seventh harmonics. An example of a DECrease printout appears below.

626

```
3A DEC 09:08:30.22
   THD      001.2 %
   HARM 7   000.2 %
   HARM 6   000.1 %
   HARM 5   000.4 %
   HARM 4   000.0 %
   HARM 3   001.2 %
   HARM 2   000.2 %
   FUND     115.3 A
```

626A,G,R,ARA

```
   FUND     115.3 A
   HARM 2   000.2 %
   HARM 3   001.2 %
   HARM 4   000.0 %
   HARM 5   000.4 %
   HARM 6   000.1 %
   HARM 7   000.2 %
   THD      001.2 %
3A DEC 09:08:30.22
```

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2.6.3 High Distortion Printouts

A High Distortion printout indicates that the THD has exceeded the programmed THD high limit. The printout includes the Mainframe's slot number (1-5), the channel phase letter (A, B, or C), the message "HI," and the time of occurrence (within 0.01 seconds). An example of a High Distortion printout appears below.

```
3A HI  10:07:22.23
```

2.6.4 Normal Distortion Printouts

A Normal Distortion printout indicates that the THD was greater than the THD high limit but has returned to within limits. The printout includes the Mainframe's slot number (1-5), the channel phase letter (A, B, or C), the message "NOR," the time it returned to within limits, the maximum THD value reached while out-of-limits, the fundamental amplitude when the maximum THD was recorded, and the relative levels of the second through seventh harmonics when the maximum THD was recorded. An example of a Normal Distortion printout appears below.

626

```
3A NOR 10:07:34.44
   HI  005.2 SEC
   MAX THD 002.3 %
   HARM 7  000.6 %
   HARM 6  000.1 %
   HARM 5  001.0 %
   HARM 4  000.1 %
   HARM 3  002.0 %
   HARM 2  000.1
   FUND 109.3 A
```

626A,G,R,ARA

```
   FUND 109.3 A
   HARM 2  000.1 %
   HARM 3  002.0 %
   HARM 4  000.1 %
   HARM 5  001.0 %
   HARM 6  000.1 %
   HARM 7  000.6 %
   MAX THD 002.3 %
   HI  005.2 SEC
3A NOR 10:07:34.44
```

2.6.5 Miscellaneous Printouts

The plug-in will report certain conditions under which it is unable to perform its normal operations. Table 2-3 lists these conditions and the resulting messages which occur.

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Table 2-3. Miscellaneous Printout Messages

Message	Meaning
SYNC LOST	The plug-in is unable to lock onto the signal applied to the SYNC VOLTAGE input. No measurements can be made until synchronization is achieved.
SYNC RESTORED	The plug-in has locked onto the synchronization signal.
FUND TOO LOW	The amplitude of the fundamental frequency component of the signal applied to the indicated channel is too low (less than 3 A rms). No measurements will be made for the indicated channel until a signal of sufficient amplitude is detected.
FUND RESTORED	The amplitude of the fundamental frequency component of the signal applied to the indicated channel is now sufficient (at least 3 A rms) for normal operation.
INPUT OVERLOAD	The peak value of the signal applied to the indicated channel has exceeded the full-scale range. No measurements will be made for the indicated channel until the input level is reduced to acceptable limits.
OVER RANGE	The rms value of the signal applied to the indicated channel is too high; the plug-in cannot tolerate a crest factor as high as specified. Measurements will continue unless an INPUT OVERLOAD is detected.
INPUT RESTORED	The input level of the signal applied to the indicated channel is now within acceptable limits. Monitoring will proceed normally.

2.6.6 Data Summary Printouts

While in the Operate Mode, pressing [DATA] will cause the plug-in to generate a Data Summary printout. For each channel, the printout will include the number of times THD exceeded the THD high limit, the highest THD reached during the most severe out-of-limits condition, and present values for THD, fundamental amplitude, and individual harmonic levels.

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The message "FUND TOO LOW" indicates that the signal level applied to the indicated channel is insufficient to produce meaningful values.

The message "INPUT OVERLOAD" means that the signal level applied to the indicated input exceeds the maximum full scale range. Note: Present values shown for this condition are for reference only and are not necessarily accurate.

The message "SYNC LOST" means that the plug-in is not locked onto a signal at this time and therefore cannot provide measurement values.

The following example Data Summary printout is from a 6024B plug-in with 109.3 A rms applied to Phase A and no connection to Phases B or C.

626

```
FUND TOO LOW

PHASE C

FUND TOO LOW

PHASE B

HARM 7   000.6 %
HARM 6   000.1 %
HARM 5   001.0 %
HARM 4   000.1 %
HARM 3   002.0 %
HARM 2   000.1 %
FUND     109.3 A
THD      002.3 %

PHASE A

PRESENT VALUES

PHC MAX THD 000.0%
PHC HI HITS  0000
PHB MAX THD 000.0%
PHB HI HITS  0000
PHA MAX THD 006.3%
PHA HI HITS  0002

626-PA-6024B
CH 3
```

626A,G,R,ARA

```
CH 3
626-PA-6024B

PHA HI HITS  0002
PHA MAX THD 006.3%
PHB HI HITS  0000
PHB MAX THD 000.0%
PHC HI HITS  0000
PHC MAX THD 000.0%

PRESENT VALUES

PHASE A

THD      002.3 %
FUND     109.3 A
HARM 2   000.1 %
HARM 3   002.0 %
HARM 4   000.1 %
HARM 5   001.0 %
HARM 6   000.1 %
HARM 7   000.6 %

PHASE B

FUND TOO LOW

PHASE C

FUND TOO LOW
```

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2.6.7 Daily Summary Printouts

Every day at midnight (Series 626 time), a Daily Summary printout for all plug-ins is automatically generated. For the 6024B plug-in, the Daily Summary printout is exactly like the Data summary printout. After the Daily Summary printout is completed, the Mainframe's Summary-Data memory is cleared.

2.7 VARIOUS PRINTOUT MODES

The setting of the PRINTOUT MODE key switch on the front panel of the Series 626 Mainframe determines the amount of detail which is printed from any disturbance. The further clockwise the key is turned, up to the SYSTEM CHECK position, the more detail that is printed regarding a disturbance. Below is a list of the four key switch positions and the amount of detail printed when the PRINT-OUT MODE key is in each position.

SUMMARY ONLY

The Series 626 printer is inhibited. All data acquired by the 6024B plug-in is stored in the Mainframes's daily accumulator. A daily summary of the worst-case disturbance events is printed at midnight (Series 626 time), or whenever the black [DATA] button is pressed.

OUT-OF-LIMITS-ONLY

Disturbance data is ONLY printed when the disturbance is recorded as out-of-limits (INCrease and DECrease disturbances are never printed).

NORMAL

Out-of-limits disturbances are always printed; INCrease and DECrease disturbances are printed when the measurement is out-of-limits, but not when the measured value is within limits.

MAXIMUM DETAIL

A highly detailed printout of every disturbance recorded by the 6024B plug-in is printed.

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SECTION III
OPERATIONAL TEST

3.1 GENERAL

This section provides information for performing an operational test to verify that the 6024B plug-in is operating properly.

3.2 SYSTEM CHECK

(1) Set the FUNCTION key switch to "OPERATE."

(2) Turn the PRINTOUT MODE key momentarily to "SYSTEM CHECK," and then back to "NORMAL."

During this test, the circuitry is switched so that an on-board test signal is measured instead of the signal at the inputs. The test signal simulates a high amplitude square wave, which has only odd harmonics.

(3) Compare the actual displayed readings with those in Subsection 3.2.1 below. If any readings are out of the tolerance range, contact Dranetz Customer Service Department for further instructions (refer to Subsection 1.9, FACTORY REPAIR).

3.2.1 System Check Tolerances

Acceptable values for System Check printouts are listed in Table 3-1 below.

Table 3-1. System Check Tolerance Ranges

	Minimum	Maximum
THD	040.4 %	042.4 %
FUND	220.0 A	240.0 A
HARM 2	000.0 %	001.0 %
HARM 3	032.3 %	034.3 %
HARM 4	000.0 %	001.0 %
HARM 5	019.0 %	021.0 %
HARM 6	000.0 %	001.0 %
HARM 7	013.3 %	015.3 %

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3.2.2 Example System Check Printout

The following example shows a typical System Check printout produced by a 6024B plug-in.

626

```
HARM 7   014.3 %
HARM 6   000.0 %
HARM 5   020.3 %
HARM 4   000.0 %
HARM 3   033.6 %
HARM 2   000.0 %
FUND     207.7 A
THD      041.8 %
    PHASE C

HARM 7   014.4 %
HARM 6   000.0 %
HARM 5   020.4 %
HARM 4   000.0 %
HARM 3   033.5 %
HARM 2   000.0 %
FUND     208.4 A
THD      041.7 %
    PHASE B

HARM 7   014.3 %
HARM 6   000.1 %
HARM 5   020.5 %
HARM 4   000.1 %
HARM 3   033.6 %
HARM 2   000.0 %
FUND     217.8 A
THD      041.9 %
    PHASE A

 626-PA-6024B
    CH 3
```

626A,G,R,ARA

```
      CH 3
626-PA-6024B

    PHASE A
THD      041.9 %
FUND     217.8 A
HARM 2   000.1 %
HARM 3   033.6 %
HARM 4   000.1 %
HARM 5   020.5 %
HARM 6   000.1 %
HARM 7   014.3 %

    PHASE B
THD      041.7 %
FUND     208.4 A
HARM 2   000.0 %
HARM 3   033.5 %
HARM 4   000.0 %
HARM 5   020.4 %
HARM 6   000.0 %
HARM 7   014.4 %

    PHASE C
THD      041.8 %
FUND     207.7 A
HARM 2   000.0 %
HARM 3   033.6 %
HARM 4   000.0 %
HARM 5   020.3 %
HARM 6   000.0 %
HARM 7   014.3 %
```

The above printout verifies the operational integrity of the 6024B plug-in for all three measurement phases (A, B, and C). The plug-in passes the System Check because all three values are within the tolerances of Subsection 3.2.1.

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APPENDIX A

ADJUSTMENTS WHEN USING ALTERNATIVE CURRENT PROBES

A.1 GENERAL

All 6024B plug-ins beyond Serial Number 690116XXX, Lot #4690-1 can be used with the TR-2019A current probe supplied with the plug-in, or with any of the following probes:

- TR-2021 probe (P/N 114700-G1)
- CT Termination Box (P/N 110635-G2)
- CT Termination Box (P/N 110635-G2) in conjunction with the TR-2015A probe (P/N 114390). The Termination Box and probe are packaged together as P/N 110639-G1.
- CT Termination Box (P/N 110635-G2) in conjunction with a probe with a 5A rms full scale secondary.

A.2 ADJUSTMENTS

The 6024B plug-in readings are based on information read in using a TR-2019A current probe. When using probes other than the TR-2019A, these readings must be adjusted by the user to compensate for the difference in amperage supplied to the 6024B by the other probes. These adjustments are discussed in the following subsections and summarized in Table A-1.

If the TR-2019A probe is used, no adjustments need to be made.

A.2.1 TR-2021 Probe

If the TR-2021 probe is used, the fundamental in the printout has to be divided by 10. All other readings (second through seventh harmonic and THD percentages) are correct as they are.

A.2.2 TR-2015A Probe

If the TR-2015A probe is used, the fundamental in the printout has to be multiplied by 10. All other readings (second through seventh harmonic and THD percentages) are correct as is.

A.2.3 CT Termination Box (Alone)

If the CT Termination Box is used alone, the fundamental in the printout has to be divided by 60. All other readings (second through seventh harmonic and THD percentages) are correct as is.

A.2.4 Other Probes

When using an industrial probe with a 5A rms full scale secondary, the general formula for adjusting the fundamental in the printout is:

$$\frac{\text{(Value in Printout)} \times \text{(Full Scale rms Rating of Probe)}}{300}$$

NOTE

Never exceed the maximum rating of the current probe.

All other readings (second through seventh harmonic and THD percentages) are correct as is.

Table A-1. Adjustments to Fundamental Reading

Probe	Multiply Fundamental By:
TR-2019A	1
TR-2021	0.1
TR-2015A w/CT Term. Box	10
CT Termination Box Alone	0.01667